Partial Differential Equations and Integral Transforms
Objectives

Text: Elementary Applied Partial Differential Equations
R. Haberman, 3rd edition.

1. Be able to define what a partial differential equation (PDE) is.
2. Be able to determine the order of a PDE.
3. Know how to classify a PDE as linear, quasi-linear or nonlinear.
4. Be able to state the principle of superposition, the PDE's it applies to, and why it is useful.
5. Be able to classify second order linear PDE's as parabolic, hyperbolic, or elliptic.
6. Know the difference in behavior of solutions of the canonical parabolic, elliptic, and hyperbolic PDE's.
7. Know how to solve the heat (diffusion) equation for a one-dimensional rod with various boundary conditions.
8. Be able to solve Laplace's equation inside a rectangle with various boundary conditions.
9. Be able to solve Laplace's equation in the interior of a disk.
10. Know what a periodic function is, and know how to find the Fourier series of a given function defined on the interval (a,b).
11. Be able to expand a function given on the interval $[0,L]$ in a Fourier cosine or Fourier sine series, and know what the Fourier series converge to.
12. Know when it is permissible to integrate and differentiate Fourier series.
13. Use eigenfunction expansions to solve the wave equation for a finite string with fixed ends.
14. Be able to state the properties of the eigenvalues and eigenfunctions of a regular Sturm-Liouville problem, and give an example.
15. Be able to solve the rectangular vibrating membrane by separation of variables.
16. Be able to solve the circular vibrating membrane by separation of variables.
17. Be able to identify Bessel's equation and know properties of its solutions.
18. Know how to apply separation of variable methods to nonhomogeneous PDE's, for example: forced vibrations of a wave equation or Poisson's equation.
19. Know how to solve linear first order equations by using the method of characteristics.
20. Be able to solve quasi-linear PDE's using the method of characteristics.
21. Be able to use D'Alembert's solution for the wave equation to solve the initial value problem for the infinite string.
22. Be able to define the Fourier transform of a function.
23. Know the basic properties of the Fourier transform, and how to use it to solve linear constant coefficient PDE's.
24. Know how to use the convolution theorem for Fourier transforms to simplify the solutions of PDE's obtained using Fourier transforms.